Space Weather Technical Forecast

Issued on Thursday, 27 June 2024 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Chance of Active to G1 Minor Storms, mainly day 2 and 3 (28-29 Jun).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with occasional low level C-class flares. The peak flare was a C4.8 event at 27/0428 UTC from AR3729 near the east limb. This is a fairly simple region magnetically, but may reveal more complexity as it rotates further onto the visible disc. Similarly complex is AR3723 in the southeast. It contains a wide string of small spots, with some mixing of polarities, but some slow decay in its intermediate region. There are ten regions on the disc, however these remained largely stable and are either unipolar, mature spots or simple bipolar regions.

No Earth-directed CMEs occurred, although a few limb-based eruptions were observed.

Solar Wind / Geomagnetic Activity: Slow wind conditions dominated through the period, but potentially with transient enhancements. Solar wind speeds observed by ACE at L1, were background, between 320-380 km/s but on a generally declining trend. Density though initially average, increased to become predominantly above average from 26/2130 UTC, with a further, more abrupt increase in density was observed around 27/1130 UTC, peaking at 21ppcc at 27/27/1139 UTC. Interplanetary Magnetic Field, Bt, was largely weak, but became persistently moderate from 27/0713 UTC, increasing to 13nT at peak. Bz, varied weakly for much of the period, but generally rotated to a moderately positive (northward) direction from 27/0630 UTC (peak +10nT). Phi angle was mostly positive (away from the Sun) until 26/1940 UTC, then rotated to a largely negative (towards the Sun) sector. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background with no solar radiation storms occurring. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The 24-hour fluence remained below Active, with 1.16e6 integrated pfu observed at 27/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: Three CMEs feature in the forecast period, all from filament eruptions. The first from 23 Jun is expected to miss, but may have a glancing impact on day 1 (27 Jun). The second from early on 25 Jun is likely have a glancing impact on day 2 (28 Jun). The third CME from late on 25 Jun is likely to arrive late day 3 or early day 4 (29-30 Jun), but any impact is expected to be rather weak and slow. Otherwise, solar winds are expected to remain indicative of a slow background conditions. Geomagnetic activity is expected to be Quiet overall with Unsettled intervals, but increasing to Active to G1 Minor storm with any CME arrivals, most likely day 2-3 (28-29 Jun).

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur from the numerous sunspots that currently occupy the visible disc. High energy electron flux is forecast to be at background. The associated 24-hour fluence is expected to remain well below the Active threshold.

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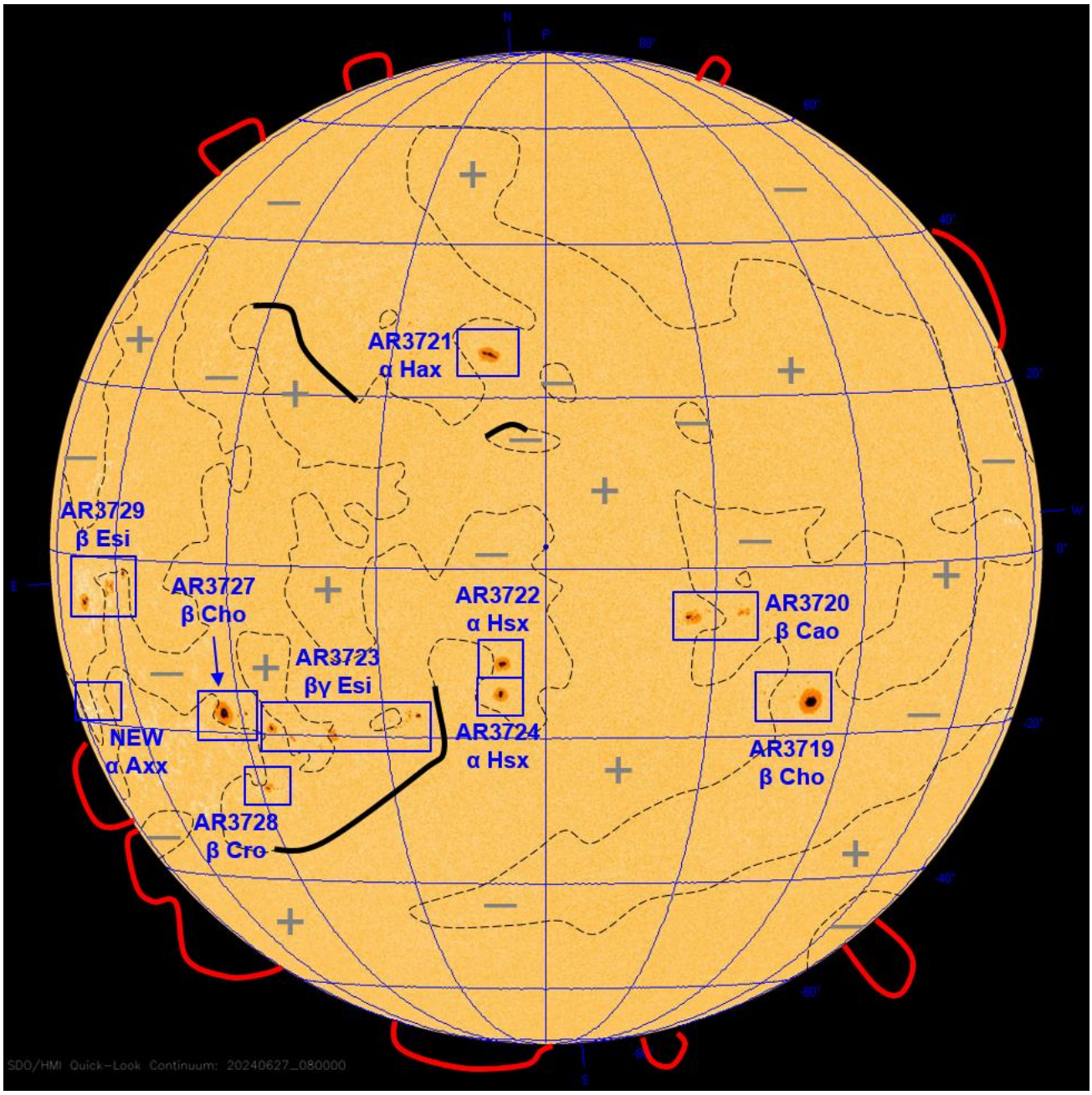
Figure 1. Solar Analysis Valid 27/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are three CMEs of note in the forecast. The first, is associated with a filament eruption on 23 Jun and is expected to miss just behind and south of Earth. However, a weak glancing influence cannot be completely ruled out late on day 1 (27 Jun), giving a chance of Unsettled to Active intervals.

The second CME is due to the large filament disruption off the west disc early on 25 Jun, resulting in a broad asymmetric partial halo as seen from STEREO A. This CME has a potential Earth directed component possibly arriving late on day 3 (28 Jun). Although the CME was slow, and only a glancing blow is indicated, filament eruption CMEs can be rather dense on arrival, with a chance of giving a period of Active to G1/Minor geomagnetic storms.

The third CME was associated with a C3.9 flare from near AR3720 late on 25 Jun. There was a weak signal in LASCO C2 imagery, with a southward directed partial halo due to the south-centre source location. Arrival is anticipated late day 3 (29 Jun) or early day 4 (30 Jun), also with the potential for a further period of Active to G1 Minor Storm intervals.

There are no coronal holes on the Earth-sided disc, so aside from any CME arrivals, solar winds are expected to remain indicative of a the slow wind. Background solar wind speeds are expected to persist and mainly Quiet geomagnetic activity.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	25	40	25
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/0054	Nil	Filament	SE	436 km/s	Missing	Small chance of glance on 27 Jun
25/1527	Partial	Filament	SW	446 km/s	28/2100 +/- 6hrs	Glancing impact expected
26/0701	Partial	C3.9 AR3720 + Filament	S-Centre	400 km/s	29/1400 +12/-6hrs	Only weak impact likely

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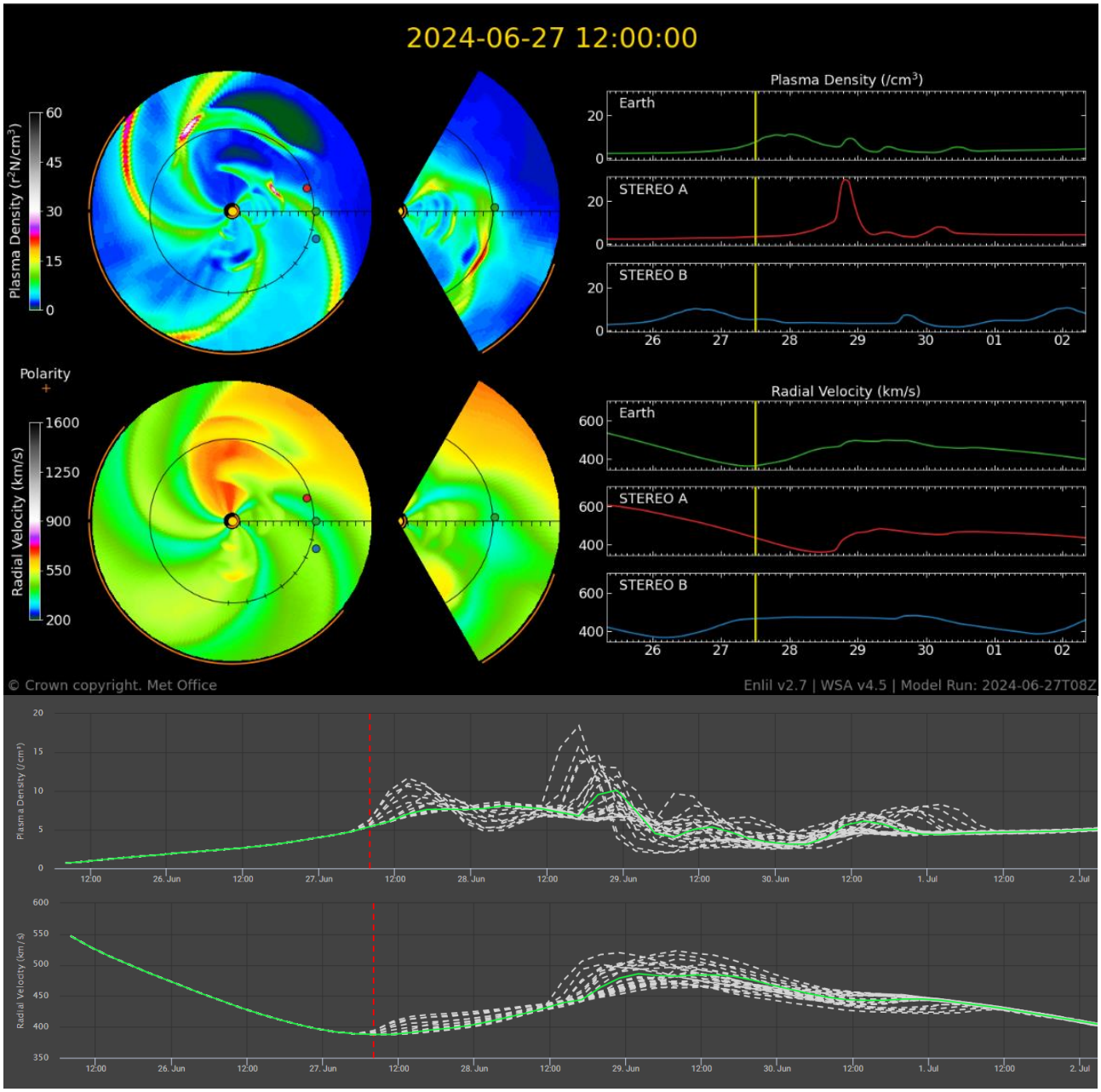
Figure 2: Latest MOSWOC Enlil and Ensemble output



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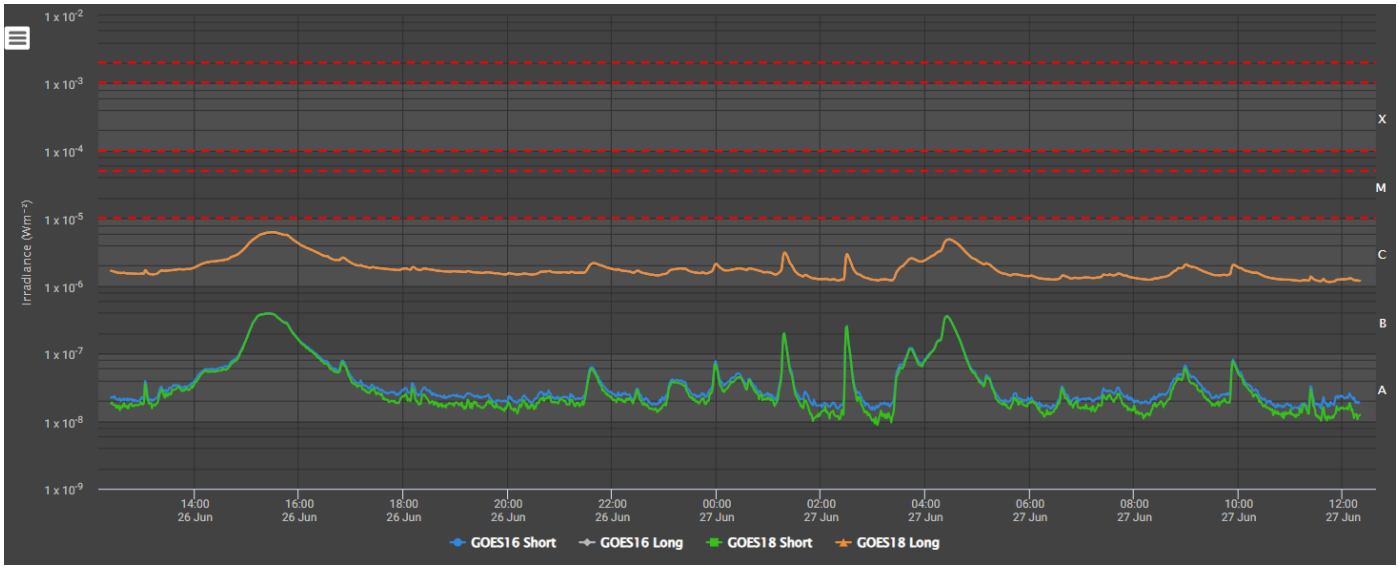
Radio Blackouts - X-Ray Flares:

Low to Moderate activity is expected with an ongoing daily chance of isolated M-flares.

There are ten regions on the disc, however the majority of these are relatively small, stable and of a simple magnetic configuration. AR3723 in the southeast is one of the most complex regions, as a wide string of small spots, with some mixing of polarities, leading to a beta-gamma configuration. To the east of this region, AR3727 is dominated by a single large spot, with surrounding smaller small spots leading to some slight complexity. These two regions are part of a messy complex of magnetic fields and plage on the southeast disc, from the remnants of more active AR3694 on the last rotation. AR3729 is similarly complex to AR3723, located close to the east limb, but progressively rotating into clearer view. It appears to be of a fairly simple bipolar configuration.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	45	45	45	45
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Latest GOES16/18 X-Ray flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as measured by GOES-18, is expected to remain at background. The numerous current sunspots on the Earth-facing are either away from the better connected west limb, or relatively simple and stable, so unlikely to produce significant flares that would lead to the observed proton flux at GOES rising.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, has been at background to briefly moderate levels. With no notable sources of enhancement forecast, flux is expected to persist at these levels.

Associated electron fluence is expected to persist well below the Active threshold (1e8 integrated pfu), with MOSWOC REFM output considered to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 4: GOES16 Electron flux (above) and MOSWOC REFM forecast and recurrence (below)

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